Citation:

Kalmijn S, Curb JD, Rodriguez BL, Yano K, Abbott RD. The association of body weight and anthropometry with mortality in elderly men: the Honolulu Heart Program. *Int J Obes Relat Metab Disord.* 1999 Apr;23(4):395-402.

PubMed ID: 10340818

Study Design:

Prospective Cohort Study

Class:

B - Click here for explanation of classification scheme.

Research Design and Implementation Rating:

POSITIVE: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

To study the association between body weight and fat distribution with mortality in older males.

Inclusion Criteria:

- Male subjects from the Honolulu Heart Program
- Subjects from the original study who were residents of long-term care facilities were included.

Exclusion Criteria:

- Data from subjects who died within a year of follow-up
- Other exclusions not described in this study but may be listed in the initial research citation

Description of Study Protocol:

Recruitment - subjects were obtained from the Honolulu Heart Program

Design - Population-based prospective cohort study

Blinding used (if applicable): not applicable

Intervention (if applicable) not applicable

Statistical Analysis

- Body weight and other anthropometrics were put into quintile-based groups to allow for possible linear relationships with mortality. Age-adjusted means of risk factors were determined for each category.
- Logistic regression models were used to calculate age-adjusted absolute mortality across categories.
- Multivariate Cox regression models were used to determine adjusted relative risk of dying based on anthropometrics. Separate and concomitant dummy variables were entered for the quintile-based groups of BMI, skinfold thickness, and waist-hip ratio (WHR). Adjustments were made for confounders and for age alone. Continuous measures of weight and other anthropometrics were entered into the model as linear and quadratic term.
- Smoking status was used to calculate mortality rates and relative risks. Analyses were repeated after excluding subjects

who died within a year of follow-up.
- Interactions between each of the following pairs were assessed: BMI and WHR, BMI and skinfold thickness, and WHR and skinfold thickness.
- Tertile combinations of measurements were used to show combined effect of BMI, WHR, and skinfold thickness on mortality.

Data Collection Summary:

Timing of Measurements

- Periodic, regular follow-up was conducted since the start of the study from 1965 to 1968.
- Data from this study's follow-up were extracted from the 1991 to 1993 follow-up visits and included 4.5 years of follow-up.

Dependent Variables

- Mortality

Independent Variables

- Body weight was measured to the nearest 0.1 kilogram reading with participants in minimal clothing.
- Body mass index (BMI) was calculated as weight (kg) divided by height squared (m^2).
- Body fat composition was assessed by using Lange calipers to obtain triceps and subscapular skinfold thickness.
- Height was measured to the closest centimeter with subjects wearing no shoes.
- Waist-to-hip ratio was determined by measuring waist and hip circumference to the nearest centimeter. The waist reading was taken at the umbilical level, and the hip measurement was done around the iliac crest.

Control Variables

- Age
- Education
- Physical activity index
- Smoking
- Alcohol consumption
- Systolic and diastolic blood pressure
- Cholesterol, glucose and insulin concentrations

Description of Actual Data Sample:

Initial N: 4676 males

Attrition (final N): 3594 males

Age: 77.7 ± 4.6 years at baseline for this study, range 71 to 93 years

Ethnicity: Japanese-American

Other relevant demographics: Subjects had > 10 years of education.

Anthropometrics

Body mass index, skinfold thickness, and waist-to-hip ratio for five-year age groups

Age	n	Mean (SD)
BMI (kg/m^2)		
71-74	1070	24.2 ± 3.0
75-79	1476	23.6 ± 3.1
80-84	676	22.8 ± 3.0
85-93	372	21.9 ± 3.2

Skinfold thickness (mm)*		
71-74	1067	27.7 ± 8.8
75-79	1498	26.7 ± 9.2
80-84	682	25.1 ± 8.7
85-93	397	22.6 ± 8.0
WHR		
71-74	1075	0.95 ± 0.05
75-79	1503	0.95 ± 0.06
80-84	687	0.94 ± 0.06
85-93	399	0.93 ± 0.06

*Sum of triceps and subscapular measurements.

Location: Honolulu, Hawaii

Summary of Results:

Key Findings

- Mortality decreased with rising BMI.
- Mean BMI and other anthropometric measurements decreased with age ($P < 0.001$).
- 21.3% of subjects died during follow-up.
- Overall mortality increased from 10.8% in the age groups of < 75 years and ≥ 85 years ($P < 0.001$).
- An inverse association was noted between BMI and mortality (RR for highest vs lowest quintile = 0.4, 95% CI: 0.3-0.6, P-trend < 0.001). There was a positive association between WHR and mortality (RR for highest vs lowest quintile = 1.5, 95% CI: 1.1-2.0, P-trend = 0.004).
- Significant interactions were observed between WHR and BMI was significant ($P < 0.001$), between BMI and skinfold thickness (P = 0.003), and between WHR and skinfold thickness ($P = 0.003$).
- WHR had a positive association with mortality the medium and high tertiles for BMI ($P = 0.02$ and $P < 0.001$, respectively).
- BMI had an inverse relationship with mortality in the two lowest tertiles of skinfold thickness ($P < 0.001$).
- Skinfold thickness was inversely related to mortality in the lowest tertile of BMI only ($P < 0.001$).

Other Findings

- Mortality rates decreased with increasing BMI in former or current smokers ($P < 0.001$). The same decrease was noted in subjects who never smoked ($P = 0.002$).
- Former and current smokers had U-shaped association between WHR and absolute mortality (P-value for quadratic term = 0.02).
- Subjects with third quintile WHR measurements had lowest risk of age-adjusted mortality (RR = 0.8, 95% CI: 0.7-1.0; quadratic term $P = 0.009$).

Author Conclusion:

Low BMI may be strong predictor of mortality in the elderly. A higher waist-to-hip ratio was related to increased mortality risk.

Reviewer Comments:

Only men studied. In addition to BMI, waist-to-hip ratio should be a standard measurement obtained during a clinical assessment.

Research Design and Implementation Criteria Checklist: Primary Research

Relevance Questions

1.	Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies)	N/A
2.	Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about?	Yes
3.	Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice?	Yes
4.	Is the intervention or procedure feasible? (NA for some epidemiological studies)	N/A

Validity Questions

1.	**Was the research question clearly stated?**	Yes
1.1.	Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified?	Yes
1.2.	Was (were) the outcome(s) [dependent variable(s)] clearly indicated?	Yes
1.3.	Were the target population and setting specified?	Yes
2.	**Was the selection of study subjects/patients free from bias?**	Yes
2.1.	Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study?	Yes
2.2.	Were criteria applied equally to all study groups?	Yes
2.3.	Were health, demographics, and other characteristics of subjects described?	Yes
2.4.	Were the subjects/patients a representative sample of the relevant population?	Yes
3.	**Were study groups comparable?**	Yes
3.1.	Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)	Yes
3.2.	Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline?	Yes
3.3.	Were concurrent controls used? (Concurrent preferred over historical controls.)	N/A
3.4.	If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis?	Yes

3.5.	If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.)	N/A
3.6.	If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?	N/A
4.	**Was method of handling withdrawals described?**	Yes
4.1.	Were follow-up methods described and the same for all groups?	Yes
4.2.	Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.)	Yes
4.3.	Were all enrolled subjects/patients (in the original sample) accounted for?	Yes
4.4.	Were reasons for withdrawals similar across groups?	Yes
4.5.	If diagnostic test, was decision to perform reference test not dependent on results of test under study?	N/A
5.	**Was blinding used to prevent introduction of bias?**	Yes
5.1.	In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate?	N/A
5.2.	Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.)	Yes
5.3.	In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded?	Yes
5.4.	In case control study, was case definition explicit and case ascertainment not influenced by exposure status?	N/A
5.5.	In diagnostic study, were test results blinded to patient history and other test results?	N/A
6.	**Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were interveningfactors described?**	Yes
6.1.	In RCT or other intervention trial, were protocols described for all regimens studied?	N/A
6.2.	In observational study, were interventions, study settings, and clinicians/provider described?	Yes
6.3.	Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect?	Yes
6.4.	Was the amount of exposure and, if relevant, subject/patient compliance measured?	N/A

6.5.	Were co-interventions (e.g., ancillary treatments, other therapies) described?	N/A
6.6.	Were extra or unplanned treatments described?	N/A
6.7.	Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups?	N/A
6.8.	In diagnostic study, were details of test administration and replication sufficient?	N/A
7.	**Were outcomes clearly defined and the measurements valid and reliable?**	Yes
7.1.	Were primary and secondary endpoints described and relevant to the question?	Yes
7.2.	Were nutrition measures appropriate to question and outcomes of concern?	Yes
7.3.	Was the period of follow-up long enough for important outcome(s) to occur?	Yes
7.4.	Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures?	Yes
7.5.	Was the measurement of effect at an appropriate level of precision?	Yes
7.6.	Were other factors accounted for (measured) that could affect outcomes?	Yes
7.7.	Were the measurements conducted consistently across groups?	Yes
8.	**Was the statistical analysis appropriate for the study design and type of outcome indicators?**	Yes
8.1.	Were statistical analyses adequately described and the results reported appropriately?	Yes
8.2.	Were correct statistical tests used and assumptions of test not violated?	Yes
8.3.	Were statistics reported with levels of significance and/or confidence intervals?	Yes
8.4.	Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)?	N/A
8.5.	Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)?	Yes
8.6.	Was clinical significance as well as statistical significance reported?	Yes
8.7.	If negative findings, was a power calculation reported to address type 2 error?	N/A
9.	**Are conclusions supported by results with biases and limitations taken into consideration?**	Yes
9.1.	Is there a discussion of findings?	Yes

	9.2.	Are biases and study limitations identified and discussed?	Yes
10.	**Is bias due to study's funding or sponsorship unlikely?**		Yes
	10.1.	Were sources of funding and investigators' affiliations described?	Yes
	10.2.	Was the study free from apparent conflict of interest?	Yes